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Comments Regarding Atlantic Richfield Company's Floodplain Soil Technical Data Summary Report, Leviathan Mine Site, Alpine County, California

Thank you for the opportunity to comment on Atlantic Richfield Company's (AR) July 14, 2017 *Floodplain Soil Technical Data Summary Report,* for the Leviathan Mine Site. California Regional Water Quality Control Board, Lahontan Region (Water Board) staff has the following general and specific comments:

1. General Comment – Water Board staff is concerned about AR's application of deviations/exceptions to United States Environmental Protection Agency (USEPA) accepted statistical methodologies for Leviathan Mine Remedial Investigation/Feasibility Study (RI/FS) documents, and the lack of discussion regarding such deviations/exceptions. AR needs to explain such deviations/exceptions so reviewers can thoroughly evaluate AR's statistical methodology. In particular, Water Board staff remains concerned about AR's methodology for calculating the Reference Threshold Values (RTV) presented in this report. Water Board expressed this same concern in their September 13, 2017 comments regarding AR's *Reference Area Technical Memorandum.*

2. General Comment – Water Board staff is concerned about the lack of a registered professional stamp on technical reports. The registered professional in responsible charge of this work should stamp the report and certify to the accuracy of its contents.

3. General Comment – Water Board staff is concerned about the methodology used to define the extent of the floodplain. Typical methodologies used to define floodplain extents include development and application of a hydraulic model (e.g., HEC-RAS). The Data Quality Objectives (DQO) for determining the extent of floodplain soil may not have been satisfied since the extent of potential flooding during a 100-year or 500-year storm event has not been adequately defined or displayed on figures. Mapping the 100-year and 500-year floodplain defines the extent of flooding and areas subject to possible sediment transport during a flood event. Mapping of soil

types is considered an auxiliary investigation to hydraulically modeling the floodplain. Water Board staff recommends that AR develop and apply a hydraulic model to define the extent of floodplain. Throughout the document, reference is made to areas with potential inundation by flooding which have not been investigated for sediment transport. Therefore, Water Board staff also recommends that AR develop and apply a sediment transport model. Additionally, Water Board staff recommends that AR delineate the 100-year floodplain on all figures where the stream cross sections and sample locations are presented.

4. General Comment – With regard to discussions regarding the pooling of data, Water Board staff recommends that AR include a summary table showing the results of statistical comparisons between data sets in the report. The summary table should present all data set comparisons, the statistical method used to compare the data sets, the criteria for determining statistical differences or similarities, the outcome of the comparison (i.e., list the metals for which concentrations were found to be statistically different, and the metals for which concentrations were found to be statistically similar, and the outcome of the comparison [e.g., based on the comparison, these data sets have been pooled]).

5. General Comment, Tables – Water Board staff recommends that AR provide all ProUCL inputs and outputs for all statistical testing and analyses (e.g. Nonparametric Kruskal Wallace, Wilcoxon-Mann-Whitney, 95% Upper Confidence Level [UCL], etc.) with the report.

6. General Comment – Throughout the document, AR uses the phrase, "the concentrations of all other metals…" Water Board staff recommends that AR list the "other metals" being referenced in the text.

7. General Comment – For all boxplots, Water Board staff recommends that AR include the mean values.

8. Page ES-4, Evaluation of Field Investigation Results, second paragraph – This section includes the approach used to calculate the RTV, which is generated from the upper simultaneous limit statistic. Water Board staff continues to have concerns with both the statistical approach and the limited datasets relied upon in the *Reference Area Technical Memorandum* (Enclosure 1- Comment Nos. 3, 4, 5, 7, and 18). Water Board staff does not believe the RTV for Arsenic is correct and recommends this and other RTVs be recalculated in future draft documents that include this information, for the reasons discussed in greater detail in Enclosure 1.

9. Page 21, Section 4.1.1, second paragraph – Water Board staff is concerned that this section does not include a statement regarding mine waste in Aspen Creek. Similar to Leviathan Creek, it seems that mine waste is present along Aspen Creek in the Aspen Creek Study Area (ACSA). Water Board staff recommends that AR provides additional clarification regarding the presence of mine waste in and adjacent to Aspen Creek.

10. Page 23, Section 4.1.2.4, first paragraph and Page 24, Section 4.1.3, first paragraph – The report describes soil as geologic materials outside of active stream channels and thus not generally exposed to fluvial processes. Water Board staff recommends that AR investigate the definition and delineation of soils subject to transport in a more rigorous manner as required by the 2008 USEPA Administrative Order-Attachment 1: Statement of Work for RI/FS, Environmental Setting and Pathway Characterization, Section I.A.2. Surface Water and Sediment (e.g., developing a sediment transport model).

11. Page 28, Section 4.3.1, third paragraph, second sentence – This sentence indicates that potentially mine-related material may only be present within the Beaver Dam/Pond Complex (BD/PC), when in fact, mine-related material may be present throughout the On-Property Study Area (OPSA) and in the Downstream Study Area (DSA). Water Board staff recommends that AR revise this sentence to make it clear that potentially mine impacted waste could be present in the BD/PC, and at other locations throughout the OPSA and DSA.

12. Page 29, Section 4.3.2, third bullet – It is unclear why this Study Question is only concerned about defining the lateral and vertical extent of mine-related floodplain soil in the BD/PC. Water Board staff recommends that AR expand the Study Question to include the lateral and vertical extent of mine-related floodplain soil throughout the OPSA and the DSA.

13. Page 29, Section 4.3.2, fourth bullet – Water Board staff is not convinced that AR has demonstrated that the DQO Study Question regarding floodplain soil in Reference Study Areas (RSA) is "sufficiently similar" to floodplain soil in potentially affected areas of the OPSA and the DSA. Water Board staff expressed this same concern in its September 13, 2017 comments regarding AR's *Reference Area Technical Memorandum* (Enclosure 1- Comment No. 17). It appears that generally Cottonwood Creek exhibits higher metals concentrations than Mountaineer Creek and this may be an indication that Cottonwood Creek should not be used as a reference stream. Water Board staff recommends that AR include Upper Leviathan Creek and Upper Aspen Creek as reference streams and provide additional sampling as necessary.

14. Page 32, Section 4.3.6, whole section – One of the quantitative criteria is to have ten or more samples representative of a specific medium; however, when looking at boxplots for the depth interval of 2-6 feet below ground surface (feet bgs), as shown in Figures 6-37 through 6-41, it appears that this criterion was not satisfied. The OPSA is now combined and has eight (8) samples, the DSA, which consists of three reaches, has 13 samples, and the RSA has nine (9) samples. The floodplain soil data is intended to meet both the qualitative and quantitative acceptance criteria, and if they are not met, the need for additional sample collection is to be considered. Water Board staff is concerned that AR has not considered the need for additional sample collection and recommends that AR provide the details of their evaluation to determine whether additional sample collection is necessary. Additionally, Water

Board staff recommends that AR address the fact that only a single sample was collected at depth (6 feet bgs) in the ACSA.

15. Page 34, Section 4.3.7, third bullet – The report states that where possible, three locations along each transect within different age categories and soil types will be sampled. It appears that at the following locations, some age categories were present, but were not sampled. Water Board staff recommends that AR explain why in transect 49 (TR-49), Age Category 2 is mapped but was not sampled, and why in TR-53, Age Category 1 is mapped but was not sampled.

16. Page 42, Section 5.1.5, last paragraph – Water Board staff recommends that AR describe the procedure used in selecting locations for deeper sampling, and provide an explanation as to why sampling at these deeper intervals did not occur when saturated conditions existed. It is possible that in other times of the year and for drier precipitation years the sample locations that were saturated during AR's sampling effort could be drier and provide habitat for ecological receptors. In addition, AR should explain how many samples were collected to a depth of six (6) feet bgs.

17. Page 48, Section 5.3.2.2, fifth bullet – Water Board staff recommends that AR provide a list of analytes that had reporting limits that did not meet the Quality Assurance Project Plan (QAPP) target limits in the report.

18. Page 49, Section 5.3.2.2, second bullet – The report did not provide the "estimated numerical values" that were generated to replace the non-detect values in this report. Water Board staff recommends that AR provides these values in the report.

19. Page 49, Section 5.3.2.2, first paragraph after bulleted items on this page – Text states that the Data Quality Assessment (DQA) process considers how any deviations from planned sampling efforts impact data usability. Water Board staff recommends that AR add a section in the report that describes all deviations from the approved workplan and their possible impact on data usability.

20. Page 54, Section 6.1.2, first paragraph – Floodplain soil field portable x-ray fluorescence (FPXRF) data were collected at 49 locations in the OPSA and 84 locations in the DSA; however, Appendix 5D, Table 5D-3 provides no results for the DSA. Water Board staff recommends that AR add this data to Table 5D-3.

21. Page 58, Section 6.3, last paragraph and Figures 6-2, 6-3, and 6-4 – There is limited evaluation and discussion as to why the median concentrations of four metals (As, Cd, Fe, and Se) in the non-RI data exceed the median concentrations in the RI dataset from the ACSA, LCSA, and DSA, and no discussion of why the median concentrations for the RI RSA data significantly exceeds the medians for the non-RI RSA data. The boxplots for the non-RI and RI RSA data show that the median values for the non-RI RSA data (for As, Cr, Co, Cu, Fe, and Mn) are lower than the median values for the RI RSA data. These results are concerning in that they could indicate bias in the RI data since the RI data, when compared to the non-RI data, shows lower metals concentrations in the OPSA and DSA and greater metals

concentrations in RSA data. Water Board staff recommends that AR provide an additional evaluation related to the apparent differences in metal concentrations between the two datasets and include figures showing the sampling locations from the non-RI and RI datasets together. Additionally, it is unclear to Water Board staff why the RI data from the BD/PC is not included as part of the RI Aspen Creek and Leviathan Creek data (especially since some of the sampling locations between the two studies are in close proximity in the BD/PC area). Water Board staff recommends that AR include the BD/PC data in this evaluation and provide additional discussion in the report regarding the potential bias, as discussed above.

22. Page 59, Section 6.4.1, first paragraph and Figures 6-13, 6-14, and 6-15 – Water Board staff recommends that AR revise Figures 6-13 through 6-15 to illustrate mean concentrations instead of median concentrations, as these figures are intended to illustrate general trends in concentration moving downstream. Additionally, Water Board staff recommends that AR: a) provide similar plots for the maximum concentrations, b) provide similar figures for Aspen Creek (at least down to Leviathan Creek), and c) label all transects along the x-axis.

23. Page 60, Section 6.4.1, second paragraph and Figures 6-5 through 6-12 – For purposes of improving clarity, Water Board staff recommends that AR include Transects 1 through 4 in the BD/PC in Figures 6-5 through 6-12.

24. Page 63, Section 6.4.3.2, second paragraph – The scatter plot straight lines on Figure 6-25 are labeled 1:1 and 3:1 and not 1:1 and 2:1, as indicated in the text. Water Board staff recommends that AR correct this discrepancy.

25. Page 65, Section 6.4.3.4, first paragraph – According to Attachment G, Graph 1 of AR's *On-Property Amendment No. 9 – Beaver Pond Surface Water Monitoring Program*, surface water pH in Leviathan Creek in the Beaver Dam/Pond Complex (BD/PC) drops as much as two standard units (su) between Transects 3 and 1. If, as stated in the report, the floodplain soil/mine waste is most likely not the source of this acidification, the cause of acidification between Transects 3 and 1 remains a data gap requiring additional investigation.

26. Pages 66, Section 6.4.3.6, second paragraph – This section indicates that the DQO for determining the lateral and vertical extent of contamination in floodplain soils is limited to the BD/PC area. Water Board staff recommends that AR provide a clarification that the DQO for determining the lateral and vertical extent of contamination is not limited to the BD/PC, and identify all areas where the DQO is applicable.

27. Page 66, Section 6.4.4, second paragraph – It is reported that field observations at two sampling locations (FPS-287 and FPS-297) noted orange mineral horizons; however, the report goes on to conclude that the orange minerals are likely not post-mining related material since other nearby soils have similar concentrations and do not have orange mineral horizons. Water Board staff recommends that AR include

the analytical results for the other nearby soils that have similar metals concentrations, but orange mineral horizons were not observed.

28. Page 67, Section 6.5, second paragraph – Figure 6-31 includes results for pH that do not appear to represent the data provided in the report. There is no pH data for the RSA 0-2 feet bgs floodplain soil that is lower than pH 5 (su); however, the boxplot indicates such data exists. Additionally, preliminary checks of the calculated median for pH in this dataset resulted in a median of 7.04 (su) and a 95% Student-t UCL of 7.172 (su), and not <6 (su) as shown on Figure 6-31. Similar results were obtained for pH for the RSA 2-6 feet bgs interval (median pH 7.36 [su]) and 95% Student-t UCL of 7.604 (su). Water Board staff recommends that AR check the data used in the RSA pH analysis and provide it to Water Board staff. If corrections are necessary, AR should revise the report accordingly.

29. Page 67, Section 6.5, second paragraph – Some of the metal concentrations range over several orders of magnitude; however, it appears the data could be plotted without using the log scale. Water Board staff recommends that AR plot all log-scale figures on normal scale throughout the report.

30. Page 68, Section 6.5, third paragraph – The report states that the soil chemical data for samples collected from the depth intervals 2-4 feet bgs and 4-6 feet bgs from the ACSA and LCSA were pooled because of the small sample size for each for comparison to soil data collected in the RSA, but the BD/PC was evaluated separately. If the data from the BD/PC was included in the soil data for the LCSA, would the sample size be of sufficient size to eliminate the need to pool it with ACSA? Also, regarding Table 6-13, Note 1 reports that only three samples were collected in the ACSA between 2 and 6 feet bgs. Please explain how it is reasonable to expect that three samples will provide a statistically meaningful representation of the ACSA.

31. Page 68, Section 6.5, third paragraph – The report states that, "The soil concentrations of Sb, Be, Cr, Cr(IV), Pb, Mn, and V the BD/PC floodplain soil were significantly greater than concentrations in the RSA soil (Table 6-13 and Figures 6-37 through 6-41)." Based on Table 6-13, it appears that with the exception of V, AR has listed the wrong metals in the text. Water Board staff recommends that AR verify the listed metals and revise the report accordingly. Figures 6-37 through 6-41 do not include boxplots for the BD/PC as indicated in the text. Water Board staff recommends that AR provide boxplots for the BD/PC in Figures 6-37 through 6-41.

32. Page 74, Section 7.1, first paragraph – The text indicates AR randomly selected the transects. Water Board staff recommends that AR describe in more detail how it randomly selected the transects and provide documentation of the selection process.

33. Page 82, Section 7.3.1 and 7.3.2, first paragraph in each section and Tables 7-3 through 7-6 – Water Board staff is concerned that metals that exceed a RTV can be eliminated as a Constituent of Further Interest in the Ecological Risk Assessment

(ERA). According to the criteria set forth in the report, for a metal to be considered a Constituent of Further Interest it must exceed a RTV and a screening level. Water Board staff recommends that AR include all metals that exceed a RTV and/or a screening level as Constituents of Further Interest. Further, Water Board staff recommends that AR consider making the Chemicals of Potential Ecological Concern (COPECs) and the Chemicals of Potential Concern (COPCs) consistent between the ERA and Human Health Risk Assessment (i.e., COPECs identified by the ERA should be included as COPCs in the Human Health Risk Assessment and vice versa).

34. Page 83 and 84, Section 7.4.1.2, first paragraph – Table 7-10 indicates that dermal contact with soil and inhalation of particulates are considered insignificant complete exposure pathways. Water Board staff recommends that AR evaluate dermal contact and soil inhalation as complete exposure pathways and determine if they are insignificant as part of the ERA process.

35. Page 88, Section 7.4.3, second paragraph and Table 7-11C – Water Board staff recommends that AR explain the mathematical basis for using the sample depth interval as the basis for weighing sample results.

36. Page 89, Section 7.4.3, second paragraph – Water Board staff recommends that AR explain the methodology used to determine when an Exposure Point Concentration (EPC) would significantly underestimate potential exposure at the maximum concentrations. Water Board staff recommends that AR provide an explanation as to how it determined that when a maximum concentration is more than five (5) times greater than an EPC, an additional consideration will be conducted to see how the conclusions would change if the maximum concentration was used.

37. Page 89, Section 7.4.3, last paragraph – Water Board staff recommends that AR include in the text of the report the EPCs for the metals in Reach 3 that are lower than the EPCs for the RSA.

38. Page 90, Section 8.1, second paragraph – There appears to be a typo in the text where it is stated that "floodplain soil investigations, which consisted of floodplain sampling and laboratory analysis at 20 transect locations within potentially affected reaches of Leviathan, Aspen, and Bryant Creeks". Water Board staff recommends that AR confirm that AR sampled 24 transects, and revise the report accordingly.

39. Page 91, Section 8.2, first paragraph – This section states that, "For this analysis, the null hypothesis (H_o) states that the mean floodplain soil concentration in potentially affected stream reaches are significantly greater than TBCs (e.g., screening risk levels) and/or RTVs." Water Board staff is unclear as to whether AR meant to use the term "mean" in this statement or the term "median." Water Board staff recommends that AR verify which term should be included in this statement and revise the statement accordingly. In addition, the sentence that follows the above-quoted sentence, regarding the alternative hypothesis test, includes the term "mean/median." Water Board staff recommends that AR verify whether the

statement is applicable to the mean, the median, or both and to revise the sentence accordingly. Water Board staff recommends that AR review all text regarding hypothesis testing to verify that the language is clear and correct throughout the document (including Section 4.3.5 and Section 6.5).

40. Page 92, Section 8.2, second paragraph – Water Board staff recommends that AR include a statement as to how many statistical power tests could not be completed since they did not meet the assumption of normality. Additionally, Water Board staff recommends that AR discuss the implications of the 26 tests (of 82 conducted) that had statistical power less than the DQO criteria of 80 percent.

41. Page 94, Section 9.0, sixth bullet – With regard to comparison of floodplain soil data from non-RI (David Evans and JBR, 2004) and RI studies, the report states that the non-RI data will be used only for comparison to RI datasets to support or confirm conclusions based on datasets collected under RI/FS protocols; however, the report does not provide a definitive conclusion as to whether the non-RI data supports or confirms conclusions drawn from the RI dataset. Water Board staff recommends that AR provide a definitive statement as to whether the non-RI dataset supports or confirms the conclusions drawn from the RI dataset, and whether the conclusions drawn from the non-RI data (see the first four bulleted paragraphs of page 18 of the report) match up with those based on the RI data. Water Board staff notes that the report discusses possible causes for inconsistencies between the non-RI and RI datasets, including differing sampling protocol (i.e., sieving of non-RI samples) and sampling design (i.e., consideration of soil age category for RI samples), but then the report goes on to indicate that these differences in sampling procedures are not expected to have a significant impact upon consistency between the non-RI and RI datasets.

42. Page 96 and 97, Section 9.0, last bullet – The first and last sentences in this bullet seem to contradict each other. The first sentence states, "The range of metals concentrations observed in floodplain soil in the BD/PC is generally consistent with the range of concentrations observed in the other study areas." Water Board staff recommends that AR provide additional clarification regarding this sentence as to the meaning of "other study areas" as this could be interpreted to include the RSA. The last sentence then states that 11 metals have a higher median concentration in the ACSA and BD/PC than the other study areas. Water Board staff recommends that AR revise this bullet to be more clear on what the data show.

43. Table 6-13 – The table title indicates that the table is referring to pooled samples between 0-2 feet bgs and 4-6 feet bgs, but Note No. 3 indicates that the data is pooled from 2 to 4 feet bgs and 4 to 6 feet bgs. Please clarify. Additionally, a quick check of the results for Arsenic and the Null Hypothesis test of OPSA > RSA yielded results different than what is shown in the Table. The results were that the OPSA data was significantly higher than the RSA for Arsenic and the Null Hypothesis should be accepted; whereas, in the Table the Null Hypothesis is rejected. Water Board staff recommends that AR verify the results, revise the report accordingly, and provide the ProUCL input and output for all statistical tests.

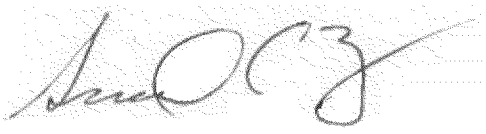
44. Table 7-6B – The LCSA results for maximum detected Arsenic concentration is shown as 38.3 milligrams/kilogram on a dry weight basis (mg/kg-dw) (2-6 ft. bgs), but data provided for this study area for samples collected between 2-6 feet bgs have concentrations of 437, 391 and 260 mg/kg-dw. Water Board staff recommends that AR verify results for this table and revise the report accordingly.

45. Table's 7-11A, B and C – A check of the results for the concentration of Arsenic in the LCSA indicates that some of the data may not have been included in the analysis. Water Board staff obtained a 95% Student-t UCL for the concentration of Arsenic in the LCSA, 0-2 feet bgs, of 329.8 mg/kg-dw; whereas, Table 7-11A reports a value of 20.38 mg/kg-dw. Similarly, Water Board staff obtained a 95% Student-t UCL of 195.5 mg/kg-dw for the concentration of Arsenic in LCSA, 2-6 feet bgs; whereas, Table 7-11B reports a value of 27.92 mg/kg-dw. This brings into question the result of 97 mg/kg-dw reported on Table 7-11C for a weighted average of these two sampling intervals. Water Board staff recommends that AR check the values reported in Tables 7-11A, B and C and revise the report accordingly.

46. Figures 6-2 through 6-4 – Water Board staff recommends that AR provide the basis for combining the RI floodplain soil datasets for the LCSA and the ACSA, the non-RI data for Leviathan and Aspen creeks, the RI data for reference streams, and the Non-RI data for reference streams, and an explanation as to why AR does not compare the results for individual stream segments. Water Board staff also recommends that AR revise the notes for these figures to indicate that for the non-RI data, the samples were collected from 0 to 1.6 feet bgs. Water Board staff recommends that AR include the mean for the data sets presented in these figures.

47. For purposes of improving clarity, Water Board staff recommends that AR include figures that depict the topography, sample locations, age category, and analytical results for all floodplain soil results including reference stream transects (similar to Figures 6-5 through 6-12 for LCSA, ACSA, and DSA). Additionally, Water Board staff recommends that AR consider an evaluation to assess whether the concentrations of metals in floodplain soil samples collected more than 20 feet (for example) from the thalweg are statistically different than the concentrations of metals in floodplain soil samples collected less than 20 feet from the thalweg.

If you have any questions regarding these comments, please contact Hannah Schembri, Water Resource Control Engineer, at hannah.schembri@waterboards.ca.gov or (530) 542-5423, or me at scott.ferguson@waterboards.ca.gov or (530) 542-5432.



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Enclosure 1. Water Board staff September 13, 2017 comment letter on *Reference Area Technical Memorandum*.

Enclosure 1

September 13, 2017

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Comments Regarding Atlantic Richfield Company's Reference Area Technical Memorandum, Leviathan Mine Site, Alpine County, California

Thank you for the opportunity to comment on Atlantic Richfield Company's July 17, 2017 *Reference Area Technical Memorandum,* for the Leviathan Mine Site. California Regional Water Quality Control Board, Lahontan Region (Water Board) staff has the following comments:

1. Page 6, Section 2.3, number 2 – The report did not provide the "estimated numerical values" that were generated to replace the non-detect values for the ten different media evaluated in the report. Please include these values in the report.

2. Page 6, Section 2.3, number 3 – Submit all ProUCL outputs and criteria used to determine when to pool and when to segregate data sets for all media.

3. Page 6, Section 2.3, number 4 – ProUCL Version 5.1, Technical Guide, page 38 guidance on determining outliers states, "In environmental applications, outlier tests should be performed on raw data sets, as the cleanup decisions need to be made based upon values in the raw scale and not in log-scale or some other transformed space." Water Board staff has observed that a number of datasets were transformed into a normal distribution before running the outlier test, which does not follow the above-referenced guidance and tends to mask outliers and skews calculations of Reference Threshold Values (RTV's). For example, when the ProUCL outlier test is performed on Tsib arsenic raw data for reference mine waste, the values of 1,180 mg/kg-dw and 1,120 mg/kg-dw are identified as outliers. Atlantic Richfield

Company's outlier analysis for Tsib arsenic from 0-2 feet below ground surface (bgs) was not performed on the raw data set and did not identify these two values as outliers.

The basis for deviating from the ProUCL's guidance referenced, above, is unclear. The report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols. Making such information readily available will allow reviewers to more efficiently identify instances where methodology guidance/protocols are not being followed, evaluate the justification for the alternative analysis, and develop conclusions regarding the suitability of using the alternative analysis.

4. Page 6, Section 2.3, number 5 – The report states that Upper Simultaneous Limits are recommended by USEPA when the dataset is without outliers. The report indicates that the data was transformed with the Box-Cox transformation to develop a normal distribution and then the outlier test was performed on the transformed data. The result is that the outliers were not identified and the full dataset with outliers was used to develop the RTV estimate. Additionally, the statement that RTV's were calculated on non-transformed data is not accurate. The data was again transformed prior to the calculation of the RTV. As stated in Comment No. 3, above, the report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols.

5. Page 6, Section 2.3, number 5 – One additional point on distribution selection is included in the ProUCL guidance, page 38. When both Gamma and Lognormal distributions fit the acceptance criteria, the use of Gamma distribution based decision statistics is preferred to estimate the environmental parameters (RTV) over lognormal distribution based RTV estimations. ProUCL guidance includes the following regarding lognormal distributions. "A lognormal model tends to hide contamination by accommodating outliers…" and "The use of the lognormal distribution on a dataset with outliers tends to yield inflated and distorted estimates which may not be protective of human health and the environment…" For example, the arsenic Tsib 0-2 feet bgs RTV result provided in Table 3-3 is 4,081 mg/kg-dw. When the outlier test is performed on the raw data set, the values of 1,180 mg/kg-dw and 1,120 mg/kg-dw are identified as outliers, removed from subsequent analysis, and then using the Gamma distribution, a RTV result of 1,488 mg/kg-dw is produced. This example shows the significant effect analytical methodology selection can have on the results. As stated in Comment No. 3, above, the report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols.

6. Page 9, Section 3.1.1, first paragraph – Several of the reference site locations identified in the report are in close proximity to areas that were actively mined and/or are known to have mine waste materials. Additionally, constituent concentrations, such as those for arsenic from reference site locations, are in several cases[1] comparable to arsenic concentrations in mine waste soil samples taken from actively mined areas or those with known mine waste materials (Figures 6-2, 6-3, 6-C-5, and 6-C-6 from the April 23, 2016 Mine Waste Technical Data Summary Report). When evaluating Figures 6-2 and 6-3, it appears that the highest concentrations of arsenic (range of 340 – 1,900 mg/kg) are surrounding most of the reference area mine waste sampling locations that also have arsenic concentrations in the same range. This combination gives cause to call into question if all of the currently identified reference site locations should remain identified as such, or should some of them be reclassified. Given this situation, there is substantial potential that one or more of the currently identified reference site locations will need to be reclassified, creating a data gap in the reference area analysis that will need to be addressed.

   Additionally, the criteria for determining if a currently identified reference site location has or has not been affected by past mining operations and/or mine wastes is absent. Such information needs to be provided and evaluated to determine if the criteria is suitable for identifying which sites have and have not been affected by past mining operations or mine waste. The criteria used for this analysis is critical to identifying suitable reference sites/areas, and if there are remaining data gaps regarding the reference areas.

7. Page 11, Section 3.2.2, number 5 and Table 3-3 – The applicability of the statistical methodology for the 95% Upper Simultaneous Limit used is questionable. For example in Table 3-3, the range of concentrations detected for arsenic in the Tsib formation ranges from 24.2 – 1,180 mg/kg-dw, which produces a RTV of 4,081 mg/kg-dw. This value is almost four times the highest concentration of the data population, which would appear to be inappropriate for setting reference concentrations for the Remedial Investigation/Feasibility Study (RI/FS). While Water Board staff defers to USEPA on the appropriate statistical method to use, the RTV should be representative of the associated data set for each media sampled. How will this RTV be compared to potential site-impacted media? Will it be compared to a 95% upper confidence limit estimate of the mean or discrete data points or some other statistical value?

8. Page 14, Section 4.1 – In addition to sampling the four monitoring wells (MW-48, MW-49, MW-51, and MW-53) on a monthly basis in 2017, will monitoring wells MW-45 and MW-46 also be sampled on a monthly basis in 2017? If not, what is the rational for not sampling MW-45 and MW-46?

[1] Data provided in Table 3-2 shows for arsenic that the maximum concentrations for reference site location depth intervals of 0-0.5 feet bgs, 1.5-2 feet bgs, 2-4 feet bgs, and 4-6 feet bgs are 1,180 mg/kg-dw, 832 mg/kg-dw, 559 mg/kg-dw, and 874 mg/kg-dw, respectively.

9. Page 14, Section 4.2, first paragraph and Figure 4-1 – The text states that monitoring wells MW-45 and MW-46 are "reference wells" and that there is significant variability in metals concentrations between these two "reference wells." Reviewing the data presented in Appendix 4A for MW-45 and MW-46, it draws into question if MW-46 meets the criteria for reference wells as described in Section 4.0 (second bullet – "the monitoring well is located outside of the effects from mining-disturbed areas"). When comparing the dissolved arsenic concentrations of MW-46 with other site-impacted monitoring well data (contained in Figure 7-1 from the January 25, 2017 Groundwater Technical Data Summary Report Version No. 2), the value of 14.4 mg/L is greater than any other dissolved arsenic concentration data from both RI and historical measurements. It does not seem appropriate to identify MW-46 as a reference well at this time, as there have only been two sampling events which showed two orders of magnitude difference in sampling results. Additionally, Figure 4-1 should be updated as MW-45 and MW-46 are designated as "reference wells;" however, it appears that it is premature to make that designation.

   This is not the first time that identifying MW-45 and MW-46 as reference wells has been questioned. It is Water Board staff's position that based upon existing data, it is premature to designate these two wells as reference wells at this time, and that they should be identified as preliminary reference wells. Water Board staff previously commented in its March 27, 2015 *Comments on Atlantic Richfield Company's Revised Draft Final Reference Area Focused Remedial Investigation Work Plan dated February 28, 2015,* comment number 4 – "There is also concern that the proposed reference wells [MW-45 and MW-46] could be within the area where the water table has been depressed by Tunnel 5, as described in the Pit Area Hydraulic Evaluation (Appendix D)." In Atlantic Richfield Company's August 14, 2015 *Response to U.S. EPA and LRWQCB Comments on Draft Final Reference Area FRI Work Plan and Technical Memorandum – Preliminary Investigations in Reference Study Areas*, Atlantic Richfield Company states (response to comment G5), "The groundwater data from locations LOC-35 and LOC-36 will be used with existing RI and historical groundwater-related data (including data from existing monitoring wells and piezometers) to evaluate reference groundwater conditions, inform decisions about whether data gaps exist, and determine the need for additional reference wells (shallow and deep) in other hydrostratigraphic units." What is Atlantic Richfield Company's plan for reference groundwater wells in light of the results that have been presented thus far?

10. Page 16, Section 5.1.1, last sentence of section and Figure 5-1 – Reference surface water sampling locations should be labeled correctly in Figure 5-1. Please update the legend.

    It is unclear if the preliminary reference surface water sampling locations are considered in the calculation of RTVs. Additionally, Appendix 5A includes the analytical results for the reference surface water sampling locations; however, sampling locations SW-52 and SW-53 are not included in Figure 5-1. Please include or explain why these sampling locations are not included.

11. Page 17, Section 5.2.2, number one, and Figure 5C-1 and Figure 5C-2 – The text in this section describes the evaluation of surface water reference data and states the data from the five reference area creek reaches were compared using box plots and that "Based on this evaluation, it was assumed that the samples from the upstream reaches of Aspen and Leviathan Creeks were sufficiently different from the other RSA locations and could potentially be evaluated independently for the purpose of developing RTVs." When looking at Figure 5C-1 and Figure 5C-2 for dissolved and total arsenic, it appears that the concentrations found in Cottonwood Creek are over double what is found in the other reference area creek reaches. It is unclear why the upstream reaches of Aspen and Leviathan Creeks were evaluated independently from Mountaineer and Cottonwood Creeks when looking at the box plots in Appendix 5C. Please provide the justification for this approach.

    It appears that Cottonwood Creek tends to have fewer similarities in concentrations with the other reference streams and perhaps should have been evaluated independently. If this was to be the case, how would the results of this analysis change?

12. Page 18, Section 5.2.2, number 3 and 4 and Tables 5-3A, 5-3B, 5-4A, and 5-4B – The text in number three explains that the dissolved and total arsenic concentrations showed evidence for two subpopulations with the Cottonwood/Mountaineer Creek data set, which resulted in three different RTVs. This gives the RTVs for dissolved arsenic (Tables 5-4A and 5-4B) as 0.00426 for Upper Leviathan and Aspen Creek, 0.0027 for Mountaineer Creek, and 0.0091 for Cottonwood Creek (Cottonwood RTV is over double the other two values). It is unclear in this report how having multiple RTVs will be utilized/applied in the RI/FS. Please clarify.

13. Page 19, Section 6.1, second sentence and Table 6-1 – The text states, "…the sampling goal was to collect stream sediments in reference stream reaches that were sufficiently similar to stream sediments in potentially affected areas of the On-Property Study Area and the DSA." While this goal seems appropriate, only having two reference streams where sediment data was collected appears to be a limitation and appears to result in a potential data gap. Included in Table 6-1, the maximum concentrations of arsenic for the three reference stream reaches sampled are 7.47 mg/kg-dw (Lower Mountaineer Creek), 20.2 mg/kg-dw (Upper Mountaineer Creek), and 37.3 mg/kg-dw (Cottonwood Creek). The Cottonwood Creek concentration is almost double the concentration of Upper Mountaineer Creek and almost five times the concentration of Lower Mountaineer Creek and raises concern in evaluations of how "sufficiently similar" this stream sediment actually is. Additional stream sediment collection on Upper Leviathan and Upper Aspen Creeks would allow for an evaluation of the appropriateness for Cottonwood Creek sediment to represent reference concentrations.

14. Page 19, Section 6.1.1, first paragraph – The sampling depth of the upper 2-3 centimeters of sediment in the reference streams does not account for the shortfalls of this sampling approach by only focusing on recently deposited sediment. As

previously questioned in Water Board staff's March 27, 2015 *Comments on Atlantic Richfield Company's Revised Draft Final Reference Area Focused Remedial Investigation Work Plan dated February 28, 2015,* comment number 6 – "How will the 2-3 cm sample depth characterize the extent of mine waste within the stream sediment when elevated metal concentrations have been found at deeper depths?" This question was not adequately addressed, resulting in additional comments in Water Board staff's August 31, 2015 *Comments on Atlantic Richfield Company's Response to U.S. EPA and LRWQCB Comments on Draft Final Reference Area Focused Remedial Investigation Work Plan and Technical Memorandum – Preliminary Investigations in Reference Study Areas dated August 14, 2015,* comment number 6 – (reproduced below)

> "This response does not appear to address the shortfalls of the sampling approach by only focusing on recently deposited sediment. Additionally, the EPA comment letter dated November 21, 2011, states:
>
> > 15) Section 5.2.2 Stream Sediment Sampling. The text describes sampling the upper two centimeters of sediment to "…obtain baseline data for sediment of recent deposition…" While recent deposition is of interest to the RI, knowledge of older deposition is also of interest. For example, if sediment originated prior to site stabilization during the mid-1980s contains elevated chemical concentrations compared to more recent sediment, then older sediment may pose an unacceptable threat to the environment. Therefore, the stream sediment DQO and sampling must be revised to include evaluation of deeper (and presumable older) sediment to allow comparison with deeper and older sediment within the Leviathan and Bryant Creek watersheds downstream from the site.
>
> Again, how will the in-stream sediment beyond the 2-3 centimeter depth be evaluated as part of this work plan?"

This appears to continue to be a shortfall of the stream sediment sampling approach and is in need of additional sampling of older and deeper sediment that is within the stream channel, not to be confused with floodplain sampling as was included in Atlantic Richfield Company's response. This is a very important data gap that requires additional sampling to meet the DQO Problem Statement for stream sediment, which states, "In order to determine the **extent** [emphasis added] of potential site-related impacts to on-property and off-property stream sediments, COPC/COPEC concentrations in stream sediments in reference areas that approximate ambient conditions are needed to support comparisons to affected areas and human health and ecological risk evaluation (including estimates of incremental risk above ambient conditions); sampling results will also be used in remedy selection decision making." How will the stream sediment beyond 3 centimeters be evaluated to meet the DQO, above?

15. Page 20, Section 6.2.1 and Appendix 6A – There were 50 stream sediment samples collected from the three reference stream reaches with 8 samples collected from the Upper Mountaineer Creek, 15 samples collected from the Lower Mountaineer Creek, 27 samples collected from Cottonwood Creek, and no samples collected from Upper Leviathan or Upper Aspen Creeks. This sampling strategy seems very disproportionate and leads to concerns about representativeness of the data collected and its applicability. As previously commented in Water Board staff's March 27, 2015 *Comments on Atlantic Richfield Company's Revised Draft Final Reference Area Focused Remedial Investigation Work Plan dated February 28, 2015,* comment number 7 – "It is unclear why over half of the sediment samples that are proposed to be collected are located in Cottonwood Creek. The number of samples for Mountaineer Creek seems disproportionate based on the number of Downstream Area reaches it is proposed to be applied to."

    Water Board staff continues to express its concerns regarding the failure to retain Upper Leviathan and Upper Aspen Creeks as reference streams, as it has on multiple occasions in previous comment letters during the development of the Reference Area Work Plan. Staff's concerns are further supported by the resulting absence of stream sediment sampling in Upper Leviathan and Upper Aspen Creeks, the actual creeks directly impacted by past mining activities and mine waste disposal practices. Additionally, sampling results presented in Appendix 6B, specifically Figure 6B-2 – 6B-6 (Boxplot Comparisons of Reference Sediment Reaches) show what appears to be 13 (Arsenic, Barium, Beryllium, Total Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Mercury, Nickel, Selenium, and Thallium) of the 20 RI/FS metals being noticeably higher in Cottonwood Creek than Mountaineer Creek, calling into question the decision to retain Cottonwood Creek and not Upper Leviathan and Upper Aspen Creeks. Additional stream sediment data collection on Upper Leviathan and Upper Aspen Creeks could augment this data set to ensure that "sufficiently similar" stream reaches are sampled. Are there any plans to collect stream sediment data from Upper Leviathan and Upper Aspen Creeks?

16. Page 20, Section 6.2.2, numbers one, three, and five and Table 6-2 – The report summarized that the results for the stream sediment sampling were sufficiently consistent to be pooled for use in calculating the RTVs for stream sediment, although as commented, above (Comment No.15), there is concern with this sampling approach (disproportionate amount of samples from Cottonwood Creek and no samples from Upper Leviathan or Upper Aspen Creeks). As an example in Table 6-2, for arsenic, the maximum concentration in stream sediment was 37.3 mg/kg-dw, which results in a RTV of 68.5 mg/kg-dw. Given that the RTV of 68.5 mg/kg-dw is almost double the highest concentration found in stream sediment calls into question the statistical approach.

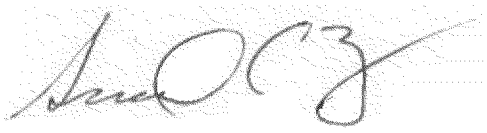
17. Page 23, Section 7.2.1 and Tables 7-2 and 7-3 – Similar to the concern with limited reference stream sediment data in the comments above, there appears to be a limitation of reference floodplain soil data as well. Table 7-3 includes results from the three reference stream reaches in 2-6 feet bgs depth interval, and the maximum

concentration for arsenic is 5.25 mg/kg-dw for Upper Mountaineer Creek, 5.42 mg/kg-dw for Lower Mountaineer Creek, and 21.8 mg/kg-dw for Cottonwood Creek. Cottonwood Creek concentration is almost four times the concentration of Upper Mountaineer Creek and Lower Mountaineer Creek. Additional floodplain soil data collection on Upper Leviathan and Upper Aspen Creeks could augment this data set to ensure that "sufficiently similar" stream reaches are in-fact sampled. Are there any plans to collect floodplain soil data from Upper Leviathan and Upper Aspen Creeks?

18. Page 25, Section 7.2.2 number 5 and Tables 7-2 and 7-4 – Table 7-2 includes the highest concentration of arsenic in Lower Mountaineer Creek with a value of 33.1 mg/kg-dw. However, when looking closer at the data included in Appendix 7A, this data point appears to potentially be an outlier as the next highest value in the table for Lower Mountaineer Creek is 8.92 mg/kg-dw. Similar to the situation discussed in Comment No. 3, above, the outlier test was not performed on the raw data. What is unclear is how the data was analyzed, so that in this case, what appears to be an outlier was not identified as such. The subsequent analysis that included the maximum arsenic concentration of 33.1 mg/kg-dw produced a RTV value of 42.5 mg/kg-dw, which does not seem to coincide very well with the data presented in Appendix 7A.

    It appears that this may be another example where the analysis deviates from applicable methodology guidance/protocols. As stated in Comment No. 3 and other comments, above, the report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols.

If you have any questions regarding these comments, please contact Hannah Schembri, Water Resource Control Engineer, at hannah.schembri@waterboards.ca.gov or (530) 542-5423, or me at scott.ferguson@waterboards.ca.gov or (530) 542-5432.



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